Archives of Orthopaedic and Trauma Surgery (2023) 143:3605–3612
https://doi.org/10.1007/s00402-022-04609-9

HIP ARTHROPLASTY

The incidence of hip dislocation after posterior approach primary total hip arthroplasty: comparison of two different posterior repair techniques

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Received: 1 February 2022 / Accepted: 29 August 2022 / Published online: 15 September 2022

Abstract

Introduction Total hip arthroplasty (THA) remains one of the most successful orthopedic surgical procedures. The posterior approach is associated with a higher incidence of post-operative dislocations than others. Adequate posterior soft tissue repair techniques, including capsulorrhaphy and transosseous bone sutures in the greater trochanter effectively reduce the dislocation rate. Post-operative "posterior hip precautions" were historically believed to reduce dislocation risks, although not clearly proven. The first protocol consists of capsulorrhaphy with the prescription of post-operative posterior hip precautions (TT) and the second, transosseous bone sutures without precautions (TB). This study aims to determine the optimal protocol to decrease the dislocation rate following posterior approach primary THA.

Materials and methods A 10-year retrospective case–control chart review analyzed demographic, pre-, intra-, and post-surgical parameters. Primary outcomes were the difference in dislocation and revision surgery rates between protocols. Secondary outcomes included the incidence of recurrent dislocations and the identification of predictors of dislocation.

Results 2,242 THAs were reviewed and 26 (1.2%) resulted in dislocation. Increased age ($p=0.04$) ASA score ($p=0.03$) and larger acetabular cup size ($p<0.001$) were associated with heightened risk. Tendon to tendon (TT) repair saw a 1.62% dislocation rate versus 0.98% for tendon-to-bone (TB) repair, although statistically insignificant ($p=0.2$). Transosseous repair resulted in recurrent dislocations for 8/16 (50%) patients compared to 6/10 (60%) in the suture group ($p\leq0.001$). No significance was found for prescription of posterior hip precautions.

Conclusions To our knowledge, this is the first study to perform a direct comparison of TT repair with posterior precautions to TB repair without posterior precautions. Similarity in dislocation rate, decreased recurrent events and the alleviated patient burden from precautions leads the authors to recommend the TB repair without precautions for a successful THA.

Keywords Total hip arthroplasty · Dislocation · Posterior hip precautions · Transosseous repair · Capsulorrhaphy

Introduction

Total hip arthroplasty (THA) is considered one of the most successful surgical procedures in orthopaedics, and the number of THAs is expected to increase by 170% globally over the next decade [1–7]. It offers tremendous pain relief, improved mobility, and quality of life [2, 6–8]. Complications following hip replacements range from 2 to 10% and of these complications, 17% are dislocations [1, 4, 9–13].

Different surgical approaches for THA have their own advantages and disadvantages [6, 7, 14–17]. A posterior hip approach refers to staying on the posterior aspect of the greater trochanter and femoral neck while exposing the hip joint [5]. Advantages of the posterior approach include less extensive soft tissue dissection, better visualization of the

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acetabulum, lower incidence of heterotopic bone formation, and preservation of the abductor mechanism. However, the posterior approach is historically associated with an increased risk of post-operative hip dislocation of up to 10% as a result of detaching the posterior capsule and short external rotators to expose the joint [7, 11, 12, 18–21]. Petis et al. found that only 36% of Canadian arthroplasty surgeons perform the posterior THA, whereas it is the most prevalent approach internationally [14].

An effective way to reduce the dislocation rate associated with the posterior approach is with adequate soft tissue repair [13, 22–25]. By closing the posterior capsule and the short external rotators, dislocation rates as low as 0.7% have been described [1]. Two main techniques for repairing the soft tissues exist. Capsulorrhaphy, referred to as tendon-to-tendon (TT) repair, involves reattaching the short external rotators and posterior capsule to the surrounding remaining soft tissues such as the stumps of the short external rotators, the capsule and abductor tendons. Transosseous bone sutures in the greater trochanter, referred to as tendon-to-bone repair (TB), involves drilling 2–3 tunnels in the greater trochanter with a 2.5 mm or 2.7 mm drill to allow sutures to be passed through them to reattach the short external rotators and posterior capsule. [14, 26–28]. A recent study measured a 6% decrease in dislocation rates in the TB repair compared to the TT repair [29]. Another similar study noted lower dislocation rates, less blood loss and lower VAS pain scores with the TT repair [30]. The hypothesis supporting this protocol is that the TT repair adds sufficient resilience to the joint to alleviate the requirement for posterior precautions.

Another method traditionally thought to lower the risk of dislocation is restricting the patient from flexing the hip past 90° and avoiding hip internal rotation or adduction past neutral position for 6 weeks post-operatively, often referred to as "posterior hip precautions" [5–8, 11, 21, 31]. This practice was adopted by many in the past but there is a lack of evidence in the literature to support its necessity [5, 6, 21]. 44% of surgeons in North America prescribe posterior hip precautions after a posterior approach [6, 32]. Special equipment is required for rehabilitation when precautions are prescribed, notably a raised toilet seat, a seat cushion, and a grip tool to help putting on shoes and socks [6–8, 21]. This equipment burdens the patient with an extra cost and stress regarding avoiding specific movements, going as far as not sleeping on the contra-lateral side [6, 11, 21].

Previous studies noted decreased dislocation rates using transosseous repair techniques [29, 30, 33]. Others questioned the necessity of posterior hip precautions as they do not improve the observed dislocation rate [6]. The authors are unaware of any literature comparing the two previously described protocols, whereby the TT repair with precautions is compared to the TB repair without precautions. The objective of this analysis is to determine the superior protocol in terms of post-operative hip dislocation rates. We hypothesized that the TB without precautions would be non-inferior to the TT repair with precautions.

Materials and methods

The authors retrospectively extracted data on all patients who experienced a dislocation following a primary THA via the posterior approach between December 2010 and December 2020 from medical archives. In our institution, the posterior approach THA is performed by six arthroplasty fellowship trained surgeons using two distinct protocols. The first protocol (3 surgeons) consists of a tendon-to-tendon (TT) repair with prescription of posterior hip precautions for the first 6 weeks post-operatively. The second protocol (three surgeons) consists of repairing the posterior capsule and the short external rotator tendons to the greater trochanter with non-absorbable sutures via drill holes in the bone without precautions (TB). A retrospective case–control design was chosen due to of the low incidence of dislocations after total hip arthroplasty. Power analysis revealed that a 1:6 case–control ratio would achieve at least 80% power (alpha 0.05 2-sided test). 156 controls were randomly selected and evaluated; 10 were excluded due to missing data. Controls included all patients who did not experience a dislocation. The surgical protocols were unchanged and performed at a proportional incidence throughout the study period. Follow-up times were identical for both groups.

Closure techniques and the prescription of precautions post-operatively were evaluated for their impact on post-operative dislocation rate. Other recorded variables include demographics, comorbidities, BMI, surgical history and protheses implanted, specifically the type of polyethylene liner (neutral vs. lipped) and component sizes. The primary outcome is the hip dislocation rate. Secondary outcomes include the rates of recurrent dislocations and revision surgeries, identification of risk factors of dislocation, complications and length of hospital stays.

Permission to collect data was obtained from the REB and Director of Professional Services. Inclusion criteria consist of a primary diagnosis of osteoarthritis and a primary THA performed by an arthroplasty surgeon at St. Mary's Hospital. Exclusion criteria include diagnoses other than osteoarthritis (e.g., avascular necrosis, inflammatory arthritis, severe hip dysplasia, post-traumatic arthritis), previous deep infection of the hip, previous surgery involving the affected hip, major

complication after surgery such as infection, periprosthetic fracture or implant subsidence/loosening.

The association between hip dislocation (outcome) and each variable (demographic, clinical and surgical) was tested using Pearson Chi-square test (categorical variables), *t*-test (continuous variables) and Kruskal–Wallis test (length of stay). The association between the protocol (TT vs. TB) and the hip dislocation outcome was tested with the multivariate logistic model; the model was fitted to account for potential confounding variables (age, sex, length of stay, ASA, patient BMI). Odds ratio (OR) and 95% confidence interval of the protocol were computed from the estimate. The significance of the non-inferiority test (comparing TB to TT) is verified by the lower limit of the 90% confidence interval and assuming a margin of 5%. All the analyses were performed with SAS Version 9.4 and STATA version 15.0.

Results

Of 2242 THA performed in the 10-year period studied, 26 dislocations occurred (1.2%). Older age at primary operation was predictive of dislocation, where the mean age was 72.9 and 67.6 years in the dislocation and control groups, respectively, ($p=0.021$). Subgroup analyses revealed a threshold of 65 years old led to the strongest predictive power ($p=0.04$). Gender and body mass index did not predict dislocations ($p=0.13$ and 0.46, respectively). ASA score was also a significant demographic predictor of dislocation. A dislocation rate of 0.08% was observed for patients with an ASA score of 1–2 compared to 2.3% for ASA 3–4 ($p=0.03$). Patient characteristics and demographics are highlighted in Table 1.

Table 2 illustrates the clinical and surgical criteria included. Although femoral head size was insignificant by itself ($p=0.18$), larger acetabular cup size was predictive of dislocation when a 36 mm head was used ($p=0.001$). Length of stay, length of surgery and type of acetabular liner were unpredictive ($p=0.12$, 0.29 and 0.16, respectively), but of note that there was only 1 patient (3.8%) who experienced a dislocation after the insertion of an elevated/lipped liner. The mean follow-up duration was similar in both groups: 66.0 months for cases and 68.4 for controls ($p=0.72$).

With regard to our primary hypothesis, TT with precautions saw a 1.62% dislocation rate whereas TB without precautions saw 0.98% dislocation rate ($p=0.2$); OR (95% CI): unadjusted = 1.66 (0.62; 4.26), adjusted = 1.54 (0.60; 4.95). A non-inferiority test was also performed, confirming that TB without precautions was non-inferior to TT with precautions ($p=0.02$). Table 3 depicts the unadjusted and adjusted regression analysis for dislocation rate by protocol.

Table 4 highlights demographic and surgical parameters by protocol. Elevated rim acetabular liners were employed more frequently for TT (22.0% vs. 8.2%, $p=0.01$). Mean follow-up for TT and TB protocols was 62.1 and 70.4 months, respectively ($p=0.12$). All other parameters were similar for both protocols.

Various clinical and surgical parameters illustrated in Table 5 present the number of dislocations experienced per patient. Twelve (46.2%) patients experienced a single dislocation, 7 (26.9%) had two, and 7 (26.9%) had three or more. TB resulted in multiple dislocations for 8/16 (50%) of patients compared to 6/10 (60%) in the TT group ($p<0.001$). Subgroup analyses revealed that 77.8% of patients with an ASA score of 3–4 dislocated multiple times compared to 43.8% of the ASA 1–2 ($p=0.07$). Age, sex, BMI, and implant sizes did not influence whether a patient would re-dislocate ($p=0.79$, 0.56, 0.47, 0.60, 0.57 and 0.80, respectively).

Revision surgeries were necessary in 20/26 (77%) cases of dislocation. 12/16 (75%) of TT patients required a revision procedure compared 8/10 (80%) of TB patients ($p=0.7$). The average interval between operations was 4.9 months. Two patients with the TB repair required a second revision, 1 and 7 months after the first revision, respectively. Prior to revision surgery, the average number of dislocations per patient was 2.1 (7 patients were revised after one dislocation, 7 after two, 6 after more than two); however, the number of dislocations experienced per patient did not predict revisions ($p=0.37$). No demographic or surgical parameters predicted the necessity for a revision surgery. All dislocations before to the revision event were treated by closed reduction in the emergency or operating room.

Discussion

The results of the present study demonstrate that the dislocation rate and the revision surgery rate post-dislocation for the two protocols are equivalent thus confirming our initial hypothesis that the TB technique provides a robust enough repair to alleviate the need for precautions. Older age, an elevated ASA score of 3–4, larger acetabular cup increased the risk of dislocation. TT also led to more recurrent dislocations than TB. Furthermore, an elevated ASA score was predictive of recurrent dislocations. Although the present analysis found larger acetabular cup sizes increased the risk of dislocation, the authors believe this finding to be an incidental finding only.

Recent evidence demonstrates a significant superiority of the transosseous repair regarding dislocations [34]. A randomized clinical trial by Moon et al. noted a 46.6% reduction of suture failure in the transosseous repair when compared

to the capsulorrhaphy (TT repair), as well as a 6% decrease in dislocation rate [29]. Although insignificant, the present analysis demonstrates a concordant 34.5% reduction in dislocation rate for the TB repair.

Posterior hip precautions prevent movements that tend to cause dislocations [5]. While precautions were originally hypothesized to prevent complications and aid in rehabilitation, their efficacy has been recently questioned [5, 6, 11, 17, 21]. A recent meta-analysis published by Crompton et al. evaluated 6900 patients and determined that posterior hip precautions did not contribute to reduce the dislocation rate [21]. Similarly, a second meta-analysis by Barnsley et al. found no evidence to support the prescription hip precautions in a population of 5816 patients [5]. An explanation for their decrease in necessity is improved prostheses and surgical techniques [12]. Furthermore, the complex nature of the precautions leads to poor compliance [5, 17, 21]. The lack of significant differences in this series is consistent with the literature [5, 6, 11, 17, 21, 31].

To our knowledge, this study is the first in the literature to perform a direct comparison of two protocols combining capsular closure type and posterior hip precautions. Although there is insufficient statistical evidence to conclude which protocol is superior, clinical factors suggest the TB repair without precautions is sufficient. Posterior hip precautions are difficult and cumbersome for patients and the additional stress and equipment costs related to precautions can become an unnecessary issue [6, 21].

The principal limitations of this study relate to the retrospective design. Retrospective case–control studies are subject to selection bias. To minimize this risk, our study included a random sample of control patients from a consecutive series who responded to the inclusion and exclusion criteria. This study has a relatively small sample size. Although our institution performs the highest volume of THAs in the province of Quebec, Canada, only 26 dislocations occurred throughout the decade-long observation period. More patients would be required to achieve additional significant predictors of dislocation. Furthermore, it is possible that the presented dislocation rate is inferior to the real rate as patients could have potentially been treated at other institutions. Although these patients would be captured in our study if they followed up with their surgeon post-dislocation, we cannot be certain of this. Finally, any medical variables thought to affect dislocation rates, such as neuromuscular disorders, alcohol abuse or smoking, were not available due to the retrospective nature of this analysis. The authors recommend that future studies consider a multi-centre, prospective design to overcome the aforementioned limitations.

Conclusion

Our institution experienced a 1.2% dislocation rate over the 10-year observation period. Older patients, higher ASA scores and larger acetabular cup sizes increased the risk of dislocation. Due to the equivalence in dislocation and revision surgery rates, the decreased recurrent dislocation rate as well as the alleviated patient burden from precautions, the authors recommend the transosseous repair without precautions protocol for a safe and successful THA.

Appendix

See Tables 1, 2, 3, 4, 5.

Table 1 Demographic parameters

	Case ($n=26$)	Control ($n=146$)	p value
Mean age (SD)	72.9 (8.7)	67.6 (11.1)	0.021*
25–64	5 (19.2%)	59 (40.4%)	
65–89	21 (80.8%)	87 (59.6%)	0.04*
Male	15 (57.7%)	61 (41.8%)	0.132
Mean BMI (SD)	27.6 (4.1)	25.8 (9.6)	0.348
< 30	7 (26.9%)	83 (62.4%)	
30–39	19 (73.1%)	46 (34.6%)	
> 40	0 (0%)	4 (3.0%)	0.460

*Statistically significant result

Table 2 Clinical and surgical criteria

	Case ($n=26$)	Control ($n=146$)	p value
Protocol			
Transosseous drill holes (TB)	16 (61.5%)	106 (72.6%)	
Capsulorrhaphy (TT)	10 (38.5%)	40 (27.4%)	0.251
Neutral liner	25 (96.2%)	126 (86.3%)	
Elevated rim	1 (3.8%)	20 (13.7%)	0.206
Average component size (SD)			
Femoral Head (mm)	36.5 (1.7)	35.7 (2.2)	0.258
Acetabular Cup (mm)	57.0 (3.5)	54.2 (4.1)	0.001*
ASA Score			
1–2	16 (64.0%)	110 (75.3%)	
3–4	10 (36.0%)	23 (15.6%)	0.033*
Mean surgical time in minutes (SD)	103.9 (25.4)	99.3 (19.4)	0.29
Mean follow-up in months (SD)	66.0 (30.5)	68.4 (31.8)	0.72
Median length of stay (days) Median [1st–3rd quartile]	4 [2–7]	3 [2–4]	0.107

*Statistically significant result

Table 3 Multivariate logistic regression for dislocation by protocol

	OR	Unadjusted (95% CI)	p value	OR	Adjusted** (95% CI)	p value
Transosseous drill holes (TB)	1.00			1.00		
Capsulorrhaphy (TT)	1.66	(0.62–4.26)	0.252	1.75	(0.62–4.95)	0.291
Age	1.05	(1.01–1.10)	0.021*	1.02	(0.97–1.08)	0.421
Male	1.90	(0.82–4.42)	0.136	0.85	(0.20–3.65)	0.829
BMI	0.98	(0.90–1.07)	0.644	0.98	(0.88–1.10)	0.745
Liner						
Neutral	1.00			1.00		
Elevated rim	0.25	(0.01–1.96)	0.188	0.30	(0.03–2.60)	0.274
Component size						
Femoral head (mm)	1.12	(0.94–1.11)	0.212	0.95	(0.82–1.12)	0.559
Acetabular cup (mm)	1.28	(1.11–1.47)	0.001*	1.43	(1.13–1.80)	0.003*
ASA Score						
1–2	1			1		
3–4	2.67	(1.05–6.77)	0.039*	3.62	(1.09–11.99)	0.035*
Length of stay	1.13	(1.04–1.24)	0.004*	1.13	(1.01–1.25)	0.028*

OR odds ratio, *95% CI* confidence interval

*Statistically significant result

**Adjusted for age, sex, BMI, liner type, femoral head size, acetabular cup size, ASA score and length of stay

Table 4 Parameters by protocol

	TB ($n=122$)	TT ($n=50$)	p value
Mean age (SD)	68.2 (11.1)	68.9 (10.5)	0.673
Male	49 (40.2%)	27 (54.0%)	0.09
Mean BMI (SD)	28.3 (5.6)	27.9 (4.6)	0.11
Median length of stay (days) Median [1st–3rd quartile]	3 [2–4]	3 [2–4]	0.382
Neutral liner	112 (91.8%)	39 (78.0%)	
Elevated rim	10 (8.2%)	11 (22.0%)	0.01
Average component size (SD)			
Femoral head (mm)	35.7 (3.8)	35.9 (1.3)	0.73
Acetabular cup (mm)	54.3 (4.4)	55.4 (3.4)	0.11
ASA Score			
1–2	88 (72.1%)	38 (76.0%)	
3–4	25 (20.5%)	8 (16.0%)	0.50
Mean surgical time in minutes (SD)	99.8 (21.5)	100.6 (17.5)	0.82
Mean follow-up in months (SD)	62.1 (27.7)	70.4 (32.8)	0.12

*Statistically significant result

Table 5 Number of dislocations experienced per patient

	Single ($n=11$)	Two ($n=8$)	More than two ($n=7$)	p value
Mean age (SD)	71.3 (10.0)	75.3 (9.2)	73.2 (5.8)	
25–64	3 (25.0%)	1 (14.3%)	1 (14.3%)	
65–89	9 (75.0%)	6 (85.7%)	6 (85.7%)	0.79
Male	7 (58.3%)	3 (42.9%)	5 (71.4%)	0.56
Mean BMI (SD)	26.3 (4.2)	28 (4.4)	29.3 (3.5)	
< 30	0 (0%)	0 (0%)	0 (0%)	
30–39	9 (75.0%)	6 (85.7%)	4 (57.1%)	
> 40	3 (25.0%)	1 (14.3%)	3 (42.9%)	0.47
Protocol				
Transosseous drill holes (TB)	8 (66.7%)	5 (71.4%)	3 (42.9%)	
Capsulorrhaphy (TT)	4 (33.3%)	2 (28.6%)	4 (57.1%)	< 0.001*
ASA Score				
1–2	10	3 (42.9%)	4 (57.1%)	
3–4	2	4 (57.1%)	3 (42.9%)	0.18
Mean component size (SD)				
Femoral head (mm)	36.7 (1.6)	36.0 (2.3)	36.6 (1.5)	0.75
Acetabular cup (mm)	57.5 (3.4)	56.0 (3.7)	57.1 (3.8)	0.65
Revision surgery				
Yes	7 (63.6%)	7 (87.5%)	6 (85.7%)	
No	4 (36.4%)	1 (12.5%)	1 (14.3%)	0.37

*Statistically significant result

Funding This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Declarations

Conflict of interest None to disclose.

Ethical approval Approved by Review Ethics Board at St-Mary's Hospital Center.

Informed consent In accordance with hospital policy and provincial regulations for retrospective studies, informed consent was not required for this study.

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